

Dec. 12, 1961

R. C. SCHIRING

3,013,155

X-RAY TABLE

Filed April 6, 1959

4 Sheets-Sheet 1

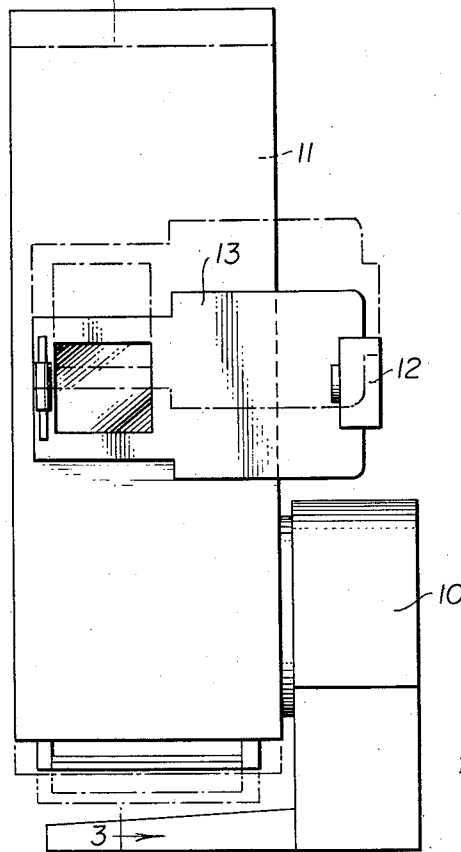
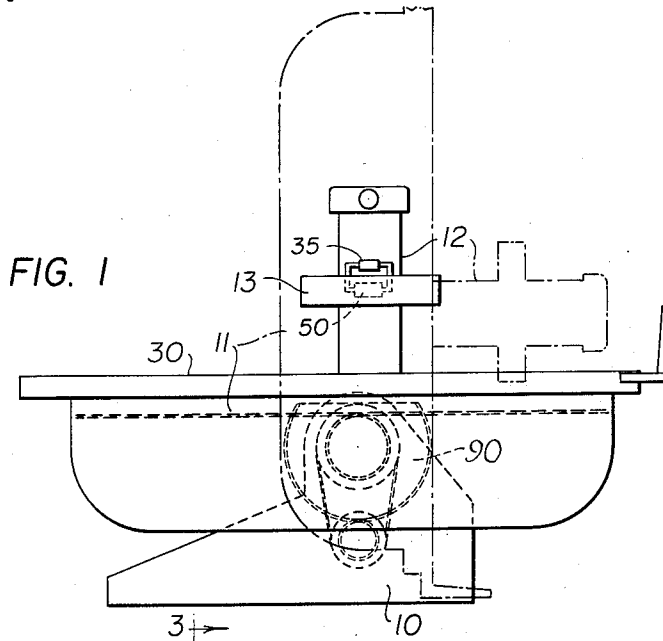


FIG. 2

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4 Sheets-Sheet 2

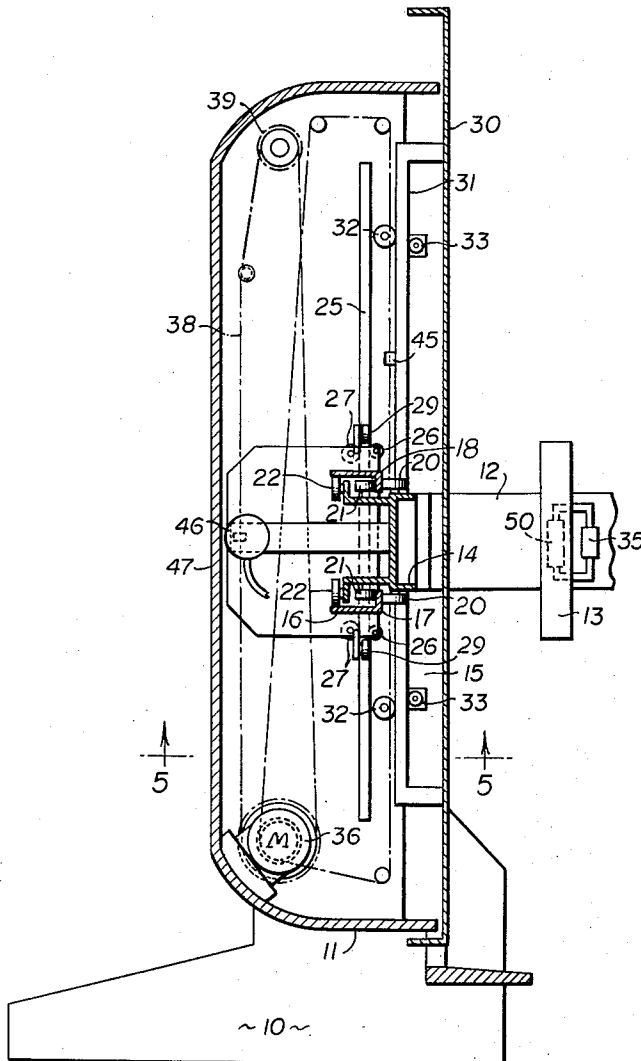


FIG. 3

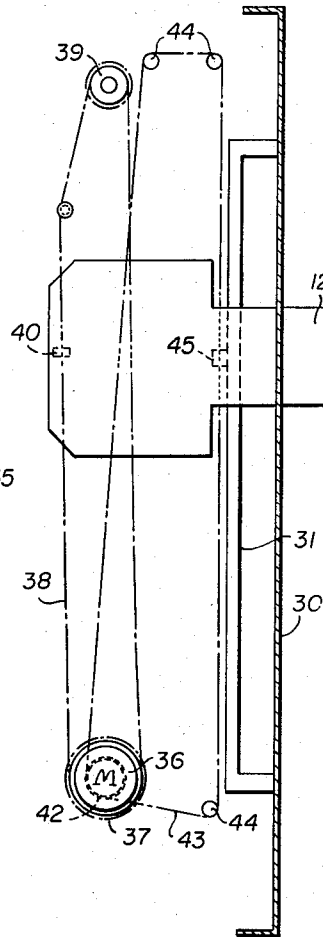


FIG. 4

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4 Sheets-Sheet 3

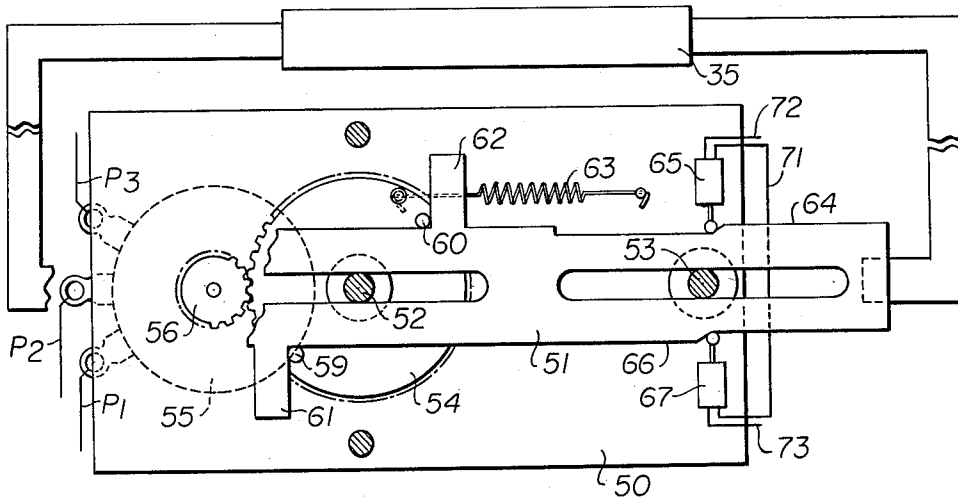


FIG. 6

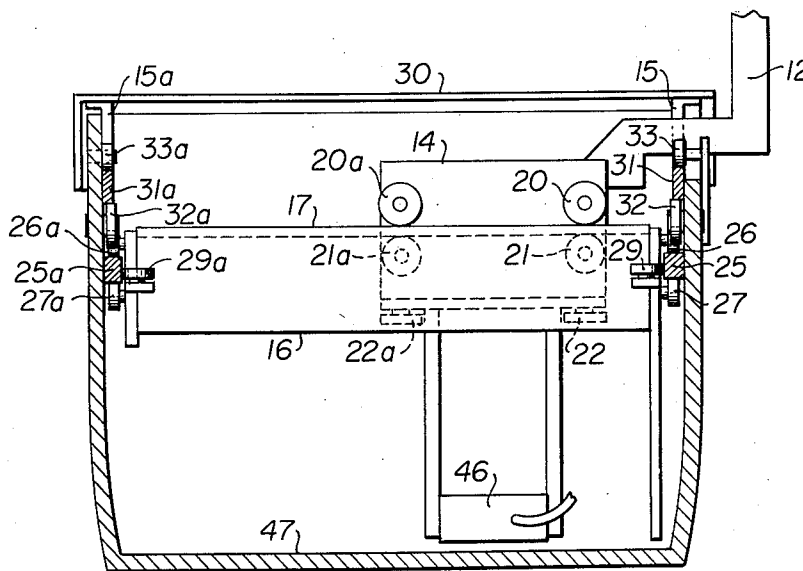


FIG. 5

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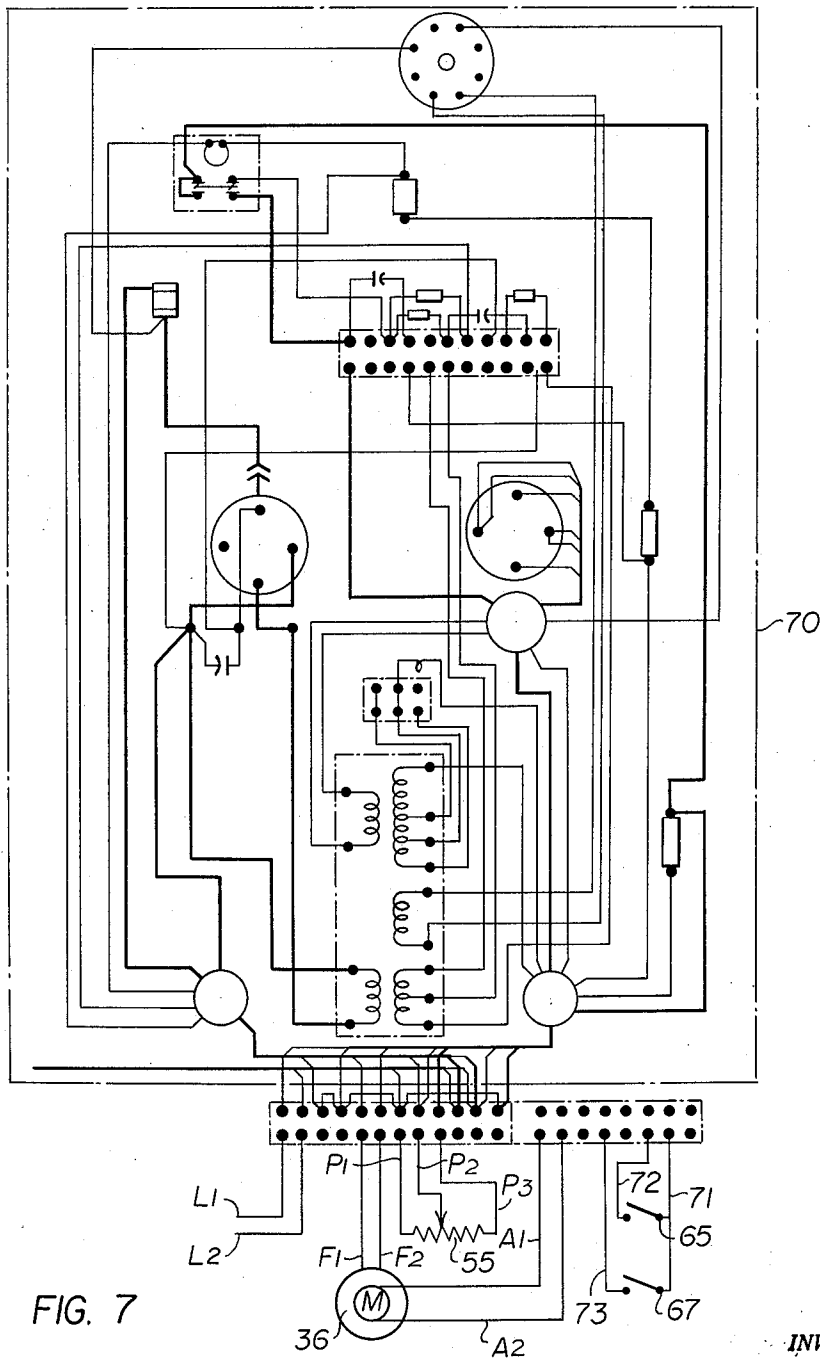
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4 Sheets-Sheet 4



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X-RAY TABLE

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Filed Apr. 6, 1959, Ser. No. 884,391
4 Claims. (Cl. 250—57)

This invention pertains to X-ray tables and more particularly to an X-ray table of the tilting type.

Tiltable X-ray tables have come into wide use and are now well known in the art. These tables have a table top and supporting structure which are movably carried on a base or pedestal to permit the table top to be moved from a horizontal position to and from a vertical position, or to any selected angle between the horizontal and the vertical positions. Normally, these tables may be tilted in a reverse direction to a so-called Trandelenburg position in which the angle of the table top is approximately 45° with the horizontal and in which a patient's head is below his feet. So-called 90-90 tables have also become well known. These 90-90 tables are movable from the horizontal to vertical in either direction and to any selected angle between the vertical extremes.

In any of the described prior tables, a guide track which parallels the table top is provided. A movable column or tower is reciprocally mounted on the track for movement in a path of travel which is longitudinal with respect to the guide. The column is also mounted for reciprocal rectilinear movement along a guide path which is transverse to the top and normal to the column travel along the guide track.

The column normally supports an X-ray head which is positioned beneath the table top. One or more image producing X-ray responsive devices such as a fluoroscopic screen, an X-ray film holding mechanism, or an image amplifier tube are supported by a carriage. The carriage is reciprocally mounted on the column for travel along a rectilinear path which is essentially normal to the table top and to the column track and path. The three rectilinear paths of travel permit the carrier to be moved to any selected position over the table top and to any selected distance from the top within the limits of the respective paths of travel.

Since the movement of the carrier relative to the column is vertical movement when the table top is horizontal, counterbalancing weights are carried in the column to facilitate vertical movement of the carrier. Thus, one pound of weight in the carrier will, with a one to one mechanical advantage, mean one pound of counterweight and therefore two pounds of weight in the column. Since the column is movable in a vertical path when the table top is in a vertical position, weights to counterbalance the column are provided in the table.

The tower or column counterbalancing weights must include one pound for each pound of carrier weight, plus one pound for each pound of carrier counterbalancing weight, plus one pound for each pound of weight of the column structure other than the carrier and its counterbalance. Thus, with one to one mechanical advantage it will be seen that for every pound of weight on the carrier, three pounds of counterbalancing weights must be added in prior known tables. With the addition of such equipment as amplifier tubes and cameras to the carriers, counterbalancing has become an acute problem. X-ray tables are becoming more and more expensive because of the cost of lead, the cost of providing external counterweights to augment the maximum which the table can carry, and because of the cost of transporting such tables.

Another disadvantage of prior tables is that the doctor, or other operator, conducting an X-ray study must move along the table the length of the portion of an anatomy

or other subject being studied. Thus, with a horizontal study, the doctor must move along the side of the table. With vertical studies a great amount of discomfort and fatiguing movement is required of a doctor because he often must move from a standing position to a "squat" position, or any position therebetween. Fluoroscopic studies are such that it is not possible for the doctor to sit on a stool or the like and move a fluoroscopic screen up and down for all studies. He must at times stand, and at other times stoop close to the ground.

The present invention overcomes these listed disadvantages, and others, through the provision of an X-ray table top which is movable relative to the remainder of the X-ray table. The table top is movable in a direction opposite to the movement of the column. Thus, when the operator moves a fluorescent screen a given distance, the distance relative to an object being studied is the distance of column movement plus the distance of table top movement in the opposite direction. Further, the top and a patient on it counterbalance, at least in part, the weight of the column. This use of the patient as part of the column counterweight permits both an increase in the amount of weight that can be carried on the column without resorting to external counterweights and it also decreases the amount of counterweight required as a part of the mechanism to balance any given column weight.

In any X-ray study the distance of the X-ray head from the object being studied is highly important. The greater the distance, the greater the cross sectional area of the study can be. The reason for this is that X-rays are emitted from a very small spot on a target. The source of the X-ray is therefore essentially a point source. The emitted rays are then collimated into a beam of any given angle. Ideally, the collimated beam would exactly cover the area of the X-ray responsive sheet being used and no more. The closer the X-ray tube is to the sheet, the wider the collimation angle must be to accomplish this objective. Conversely, the greater the distance, the narrower the collimation angle and the narrower the beam. Since the object being studied must be interposed between the X-ray tube and the sheet, it will be seen that the smaller the collimated beam angle, the greater the area of object that can be studied with a given sheet. Further, as the beam angle is made smaller, scatter radiation is reduced.

In an X-ray table the limiting factor on distance between the X-ray head and the X-ray responsive machine is the contour of the body of the table. The limiting factor on the contour of the body of the table is the height and clearance for tilting from and to vertical positions. In prior known tables providing desired table top length in a tiltable table resulted in the ends of the table body being curved inwardly. The extensive column travel relative to the table resulted in the X-ray head being spaced upwardly from the bottom of the table so that it would clear the curved ends of the body. The provision of a table top which moves relative to the table body and oppositely from the column results in a reduction of travel of the column relative to the body. This permits the X-ray head to be spaced immediately adjacent the bottom of the table body without concern for clearance of the curved ends.

In prior known tables it was necessary to construct a body which was of sufficient length to permit column movement for studies over substantially the entire length of any human body. The provision of tiltable tables with such extensive column movement has resulted in tables which are of limited depth to provide sufficient clearance for tilting.

The reduction in column travel in the present table results therefore in a reduction of required table body length. Since the table body length is reduced, the clear-

ance problem is reduced and it is possible to construct a table which is deeper than prior known tables thereby providing a further increase of the "tube to object" distance.

Accordingly, one of the principal objects of this invention is to provide a novel and improved tilt table in which the table top is movable.

Another of the principal objects of this invention is to provide a novel and improved X-ray table which minimizes the amount of operator movement required.

A further principal object of this invention is to provide a novel and improved X-ray table in which the weight of the patient or object being studied is utilized as part of the column counterbalancing weight.

An additional object of this invention is to provide a novel and improved X-ray table in which movement of the column in one direction causes movement of the table top in the other direction and in which a power source is provided to assist in such movement.

Yet another of the principal objects of this invention is to provide a novel and improved X-ray table which has a very narrow beam angle and a great tube to object distance.

Another object of this invention is to provide a power assist mechanism which is responsive to pressure exerted to move the carrier.

A related object of this invention is to provide a carrier with a movable handle in which movement of the handle actuates the power mechanism.

A similar object of this invention is to provide a handle which automatically returns to a neutral position when released to automatically stop the power assist mechanism.

A related and more specific object of this invention is to provide a mechanism made in accordance with the foregoing objectives in which the amount of power assist provided in the mechanism is proportional to the amount of pressure applied to the handle.

Another object of this invention is to provide a mechanism in which a means is provided to urge the handle toward a neutral position thereby giving the operator the impression of pushing the column.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a somewhat schematic front elevational view of the novel and improved X-ray table in a horizontal position and showing a vertical position in phantom;

FIGURE 2 is a side elevational view of the novel and improved table in the vertical position;

FIGURE 3 is a front elevational view of the device in a vertical position with the body of the table being shown in section as seen from the plane indicated by the line 3—3 of FIGURE 2;

FIGURE 4 is a somewhat schematic view on an enlarged scale showing one suitable power mechanism for shifting the table top and column relative to one another;

FIGURE 5 is a sectional view on an enlarged scale with respect to FIGURES 1, 2 and 3, indicated by the line 5—5 of FIGURE 3;

FIGURE 6 is a plan view, with parts broken away and removed, of one suitable switching arrangement for actuating the power mechanism in response to movement of a control handle; and,

FIGURE 7 is a schematic view showing a circuit, the motor and actuation power mechanism.

Referring to the drawings, a pedestal is shown generally at 10. A table body and frame 11 is supported cantilever fashion on the pedestal 10. The pedestal 10 houses a suitable drive mechanism for tilting the table from the horizontal position shown in FIGURE 1 90° to the vertical position shown in phantom, or 90° in the other direction to an opposite vertical position. A suitable tilting mechanism is shown in dotted lines at 90 in FIGURE 1.

This mechanism is shown and described in detail in Patent Number 2,872,584, issued February 3, 1959.

A tower or column 12 is supported by the table body 11. The column 12 supports a carrier 13 which is movable vertically on the column 12. The carrier 13 may support a fluoroscopic screen, a spot film device, or any of the other well known X-ray mechanisms which may suitably be mounted on the carrier. The column 12 also includes counterweights for the carrier 13 and the other usual components that are provided as part of the column assemblies of known structures.

Various guide ways or tracks to define the paths of travel of the column 12 and a movable table top 30 are provided. Wheels to follow the tracks and support the column and top are provided at both the front and the back of the table. For clarity of illustration and description, the rearward or back column and top support structures shown in FIGURE 3 will be described in detail, it being understood that the equivalent structure is provided at the front of the table. The corresponding front structures are designated by corresponding numerals, each accompanied by the letter "a."

The column 12 has a support portion 14 which projects through an elongated aperture 15 in the back of the table. The aperture 15 permits rectilinear movement of the column 13 along a path which is longitudinal with respect to the body 11. The corresponding slot 15a at the front of the table is an access slot for a well known Bucky Grid mechanism which, for clarity, is not shown.

A trolley device 16 which is known as "fluoroscopic carriage" is provided. The fluoroscopic carriage 16 includes first and second guide track members 17, 18 which extend transversely of the body 11. The column support portion 14 carries upper and lower horizontal support wheels 20, 21 respectively, which coast with the track portions 17, 18 to guide the column in rectilinear movement transverse to the table body 11. A plurality of vertical guide wheels 22 are carried by the column support portion 14. The vertical guide wheels 22 locate the support portion longitudinally relative to the body. The vertical guide wheels 22 also coast with the guide track portions 17, 18 to carry the weight of the column in rectilinear movement transverse to the table body when the body is in the vertical position.

A longitudinal guide track 25 is fixed to the body to form a portion of the body frame structure. Upper and lower column support rollers 26, 27 are fixed to the fluoroscopic carriage 16 to support the carriage and the remainder of the column 12. The rollers 26, 27 travel along the guide track 25 to carry the column 12 along a rectilinear path which is longitudinal with respect to the body 11. A pair of transverse guide rollers 29 also coast with the guide track 25 to position the fluoroscopic carrier 16 against movement transversely with respect to the body.

The table top 30 is mounted on the body 11 for rectilinear movement along a longitudinal path. The top 30 has a support track 31. A pair of support rollers 32 are positioned beneath the support track 31 to support the table top 30 in its movement along a rectilinear path.

A pair of positioning rollers 33 are also provided to coast with the top support 31. The positioning rollers 33 hold the top support 31 against the support rollers 32.

The outstanding advantages of the invention are achieved through movement of the table top 30. This advantage is enhanced by causing the movement of the top 30 to be opposite to movement of the column 12 when the column is moved longitudinally with respect to the table body 11. To accomplish this opposite movement which, in the preferred and disclosed arrangement, is simultaneous, an actuating handle 35 is provided. The actuating handle 35 is mounted on the carriage 13. The handle 35 is reciprocal along a path which is longitudinal with respect to the body 11. Through a mechanism which will subsequently be described in more detail movement of the handle 35 actuates the reversible power mechanism

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to drive the column 12 in the direction of the handle movement 35 and to drive the table top 30 in the opposite direction.

One suitable power mechanism is shown in the drawings. That power mechanism includes a reversible motor 36. The motor 36 is connected to a column drive sprocket 37. A column mechanical interconnection in the form of a drive chain 38 is reeved over the sprocket 37 and a pulley 39 at the opposite end of the table body 11. One reach of the chain 38 is fixed to the column 12. In the disclosed arrangement a connection is formed at 40 to connect the lower reach of the chain 38 to the column 12.

A table top drive sprocket 42 is also connected to the motor 36. A mechanical interconnection in the form of a top drive chain 43 is reeved over the sprocket 42 and around the plurality of top chain pulleys 44. The top chain 43 is connected to the top 30. In the disclosed arrangement a connection 45 is provided to fix the upper reach of the chain 43 to the top support 31.

With the top 30 connected to the upper reach of the top chain 43 and the column 12 connected to the lower reach of the column chain 38, rotation of the motor in either direction will cause movement of the column 12 and the top 30 in opposite directions. It will be recognized that any suitable mechanical interconnection can be substituted for the chain and sprocket arrangement disclosed, as long as there is a drive connection capable of conducting force from the motor to the top and column respectively to cause rectilinear movement as described in connection with the chain and sprocket arrangement.

The column sprocket 37 in the disclosed arrangement has a diameter that is approximately twice the diameter of the top sprocket 42. With this arrangement each movement of the table top one inch in one direction is accompanied by a column movement of two inches in the opposite direction. Thus, for each two inches of movement of the column, three inches of movement relative to the table top is obtained and the actual amount of column movement required is reduced.

Since the actual column movement required is reduced as compared with prior known tables, a whole series of advantages are obtained. The amount of movement required of the doctor is greatly reduced. This is particularly important from the standpoint of minimizing the bending and stooping required when the table is in the vertical position of FIGURES 2 and 3. An X-ray head, shown at 46, is positioned immediately adjacent bottom portion 47 of the body 11. In prior known tables it has been necessary to space the X-ray tube above the bottom of the table for clearance. The shortened column travel permits the tube to be lowered to obtain maximum distance between the X-ray head 46 and the patient, or other object, to be studied.

One suitable mechanism for actuating the motor 36 is shown in FIGURES 6 and 7. A frame 50 which houses a motor control bar 51 is provided. The frame 50 may be mounted in dotted lines in FIGURES 1 and 3. The control bar 51 is connected to the handle 35 and mounted on guide pins 52, 53 for reciprocal movement in response to pressure applied to the handle. A control gear 54 is mounted on the guide pin 52. A potentiometer 55 has an adjustment gear 56 which is in engagement with the control gear 54.

A pair of control pins 59, 60 are carried by the control gear 54. A pair of control pin actuation extensions 61, 62 extend from the control bar 51. A spring 63 urges the control gear 54 in a clockwise direction to bring the control pins 59, 60 into contact with the projections 61, 62 respectively. When the pins 59, 60 are in engagement with the projections 61, 62 respectively, the actuation mechanism is in a neutral position. Thus, the spring 63 coacts with this pin-projection engagement to serve as a positioning mechanism for the drive bar 51 and the connected handle 35.

When the control bar 51 is shifted to the left, as seen

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in FIGURE 6, in response to movement of the handle 35, the projection 62 presses against the pin 60 causing the control gear 54 to rotate in a counterclockwise direction against the action of the spring 63. As the control bar 51 is shifted to the left, the projection 61 moves away from the pin 59. Movement of the control bar 51 to the left also causes camming surface 64 to close switch 65. Switch 67 is not affected by this movement. When the handle 35 is released the spring 63 returns the entire mechanism to the neutral position.

If the control bar 51 is moved to the right as seen in FIGURE 6, the projection 61 presses against the pin 59 to cause counterclockwise rotation of the control gear 54 against the action of the spring 63. When the control bar 51 is moved to the right, the pin 60 moves with the counterclockwise movement of the gear and the projection 62 moves to the right so that the pin 60 and the projection 62 move away from one another. As the control bar 51 is moved to the right, camming surface 66 closes the switch 67 while the switch 65 is unaffected by this movement. As in the case of movement of the handle 35 to the right, release of the handle will permit the spring to return the mechanism to the neutral position.

A schematic diagram showing the control mechanism is set out in FIGURE 7. A control box is shown at 70. The control box 70 houses a suitable electronic motor control mechanism. One such mechanism is currently sold by the Master Electric Company of Dayton, Ohio, under the designation "magnetic reversing speed ranger with anti-plugging and dynamic braking." Any suitable electronic control may be employed which gives substantially instantaneous activation of the motor to start it and stop it abruptly. The control circuit should also drive the motor at a predetermined speed with any load condition within the range intended for the X-ray table.

The terminals numbered A and B of the control mechanism 70 are connected to conductors L1, L2 to provide a suitable source of potential. The terminals E, F are connected through conductors F1, F2 to the field of the motor 36. The conductors A1, A2 form a suitable connection between the armature of the motor 36 and the terminals N, M of the control box 70. The potentiometer 55 is connected through conductors P1, P2, P3 to control box contacts G, H, and I respectively. A conductor 71 connects one side of each of the switches 65, 67 to terminal S. The other side of the switch 65 is connected through conductor 72 to terminal R, while the other side of the switch 67 is connected through conductor 73 to the terminal P.

As the handle 35 is moved to the left, as seen in each of the drawings, the control bar 51 is moved to the left with it. This movement of the control bar closes the switch 65 to cause clockwise rotation of the motor. With the motor rotating in a counterclockwise direction, column 12 is shifted to the left and the table top 30 is shifted to the right. The more the handle 35 is shifted to the left relative to the carrier, the greater the resistance of the spring 63 and the greater the rotation of the potentiometer 55, and, therefore, the greater the speed of the motor 36. Thus, the mechanism gives the operator a simulated feeling of controlling the column 12 and supported carrier 13 in a manner which is identical to that which he is accustomed to. The resistance of the spring 63 gives the operator the feel of pushing the carrier 13. Further, the harder he pushes, the faster the relative movement of the carrier 13 and the table top 30.

Movement of the handle 35 to the right, as seen in the drawings, shifts the control bar 51 to the right, closing the switch 65. The closing of the switch 65 causes the motor to operate in a clockwise direction to shift the column 12 to the right and the table top to the left.

The described mechanism is an X-ray table which, when compared to prior known tables, permits, selectively, either a decrease in the amount of counterweight required or an increase in the permissible weight of the column 12

and support structure with counterbalancing that is confined within the table. The described table also permits a greater distance between the X-ray tube 46 and the patient, and a reduction in the amount of fatiguing movement required of an operator.

While this structure has been described with a great deal of detail, it is believed that it essentially comprises an improved tilt type X-ray table in which the table top is movable relative to the remainder of the table to assist in the conduction of a fluoroscopic study by permitting movement of the top while such a study is being conducted.

Although the invention has been described with a certain degree of particularity, it is understood that the present disclosure of one form of the invention has been made only by way of example, and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as herein-after claimed.

What is claimed is:

1. An X-ray table comprising a base, a hollow body movably supported by said base, said body having first and second sets of parallel longitudinally disposed guide tracks, a column reciprocally carried on the first track, a table top reciprocally carried on said second track, an X-ray head carried by the column and positioned beneath the top and within said body, an image producing X-ray responsive sheet carried by said column and positionable above and parallel to said top, reversible power means carried by said body, a first direction drive connection connecting the power means to the column, a second direction drive connection connecting the power means to the top, a reciprocal handle carried by the column, positioning means urging said handle into a central position, pressure responsive actuation means operably connected to the handle to actuate the power means in proportional response to movement of the handle, the handle being movable in one direction to actuate the actuation means and thereby the power means to drive the column in said one direction and the top in the opposite direction, and the handle being movable in the other direction to actuate the actuation means and thereby the power means to drive the column in said other direction and the top in the opposite direction.

2. An X-ray table comprising a base, a body movably supported by said base, said body having first and second sets of parallel longitudinally disposed guide tracks, a column reciprocally carried on the first track, a table top reciprocally carried on said second track, an X-ray head carried by the column and positioned beneath the top and within said body, an image producing X-ray responsive

member carried by said column and positionable above and parallel to said top, reversible power means carried by said body, a first direction drive connection connecting the power means to the column, a second direction drive connection connecting the power means to the top, a reciprocal handle carried by the column, positioning means urging said handle into a central position, pressure responsive actuation means operably connected to the handle to actuate the power means in proportional response to movement of the handle, the handle being movable in one direction to actuate the actuation means and thereby the power means to drive the column in said one direction and the top in the opposite direction, the handle being movable in the other direction to actuate the actuation means and thereby the power means to drive the column in said other direction and the top in the opposite direction, and said actuation means when actuated causing said power means to operate at a speed proportional to the extent of handle movement.

3. The device of claim 1 wherein said positioning means urges said handle toward said center position with a force which increases as the handle is moved away from said center position.

4. In an X-ray table the combination of a pedestal, a frame carried by the pedestal, a column supported on the frame and reciprocable along a path, the column including means to provide an image for an X-ray examination, means operably connected to the pedestal and the frame to tilt the frame from a horizontal to a vertical position and return, a table top mounted on the frame and reciprocable along a path paralleling the column path, a handle mounted on the column and reciprocable along a path paralleling the paths of reciprocation of the column and table, an operator controlled power means connected to the table top and actuatable by the handle to shift the table top and column reciprocally in opposite direction with respect to the frame while an image is provided for an examination and when the handle is shifted reciprocally.

References Cited in the file of this patent

UNITED STATES PATENTS

2,490,400	Berggren	Dec. 6, 1949
2,754,426	Schiring et al.	July 10, 1956
2,872,584	Schiring et al.	Feb. 3, 1959
2,966,588	Kizaur	Dec. 27, 1960

FOREIGN PATENTS

618,518	Germany	Sept. 10, 1935
633,007	Germany	July 17, 1936
1,159,891	France	Feb. 17, 1958